# Stappenplan 28 Aug

## Stap 1: extraheer factoren uit dataset

Je begint met de dataset die al is geladen en gefilterd (bijvoorbeeld met de Christiano-Fitzgerald filter).

Vervolgens gebruik je PCA (of PLS) om een matrix van 9 factoren te extraheren voor alle datapunten in je trainingsset (tot december 2019).

Deze factoren zullen de onderliggende structuur van je 66 variabelen representeren en dienen als input voor verdere voorspellingen.

*CHECK*

*Dit is de terminal uitput na check stap 1:*

*>>> from data\_loader import load\_data, filter\_data*

*>>> from utils import standardize*

*>>> from factor\_model import DynamicFactorModel*

*>>>*

*>>> # Laad en filter data*

*>>> file\_path = 'C:/Thesis/03. Data/Final version data/Static.xlsx'*

*>>> df\_data = load\_data(file\_path)*

*>>> filtered\_df = filter\_data(df\_data)*

*>>>*

*>>> # Standaardiseer data*

*>>> Y\_train\_std = standardize(filtered\_df.values.T).T*

*>>>*

*>>> # Initialiseer en pas PCA toe*

*>>> model = DynamicFactorModel(filtered\_df, num\_factors=9)*

*>>> model.std\_data = Y\_train\_std.T*

*>>> model.apply\_pca()*

*>>>*

*>>> # Inspecteer de factors matrix*

*>>> print("Shape of factors matrix:", model.factors.shape)*

*Shape of factors matrix: (9, 347)*

*>>> print("First few rows of the factors matrix:\n", model.factors[:5, :])*

*First few rows of the factors matrix:*

*[[ 6.97008786 6.03887386 3.8322957 ... 2.61886857 5.43186564*

*3.59887794]*

*[ 5.99404811 5.2211467 5.24405989 ... 10.00381723 9.42566161*

*10.75307203]*

*[-1.12879002 0.77675893 -2.21537595 ... -1.96604757 -2.17006265*

*3.09251458]*

*[-2.0293299 -4.37194985 -4.57658607 ... -3.16489002 -3.56874705*

*-3.23346493]*

*[-0.4204558 -1.86658493 -1.00839733 ... 1.2301937 0.96019515*

*0.53709331]]*

*>>>*

## Stap 2: Schat model met ElasticNet

Gebruik de verkregen factoren uit stap 1 als onafhankelijke variabelen om een ElasticNet-regressiemodel te trainen. Dit model wordt getraind om de oorspronkelijke 66 variabelen te voorspellen op basis van de factoren.

*CHECK*

*Dit is de terminal output na check stap 2:*

*>>> from data\_loader import load\_data, filter\_data*

*>>> from utils import standardize*

*>>> from factor\_model import DynamicFactorModel*

*>>>*

*>>> # Laad en filter data*

*>>> file\_path = 'C:/Thesis/03. Data/Final version data/Static.xlsx'*

*>>> df\_data = load\_data(file\_path)*

*>>> filtered\_df = filter\_data(df\_data)*

*>>>*

*>>> # Standaardiseer data*

*>>> Y\_train\_std = standardize(filtered\_df.values.T).T*

*>>>*

*>>> # Initialiseer het model en pas PCA toe*

*>>> model = DynamicFactorModel(filtered\_df, num\_factors=9)*

*>>> model.std\_data = Y\_train\_std.T*

*>>> model.apply\_pca()*

*>>>*

*>>> # Bereid de data voor de ElasticNet-training*

*>>> # Gebruik een subset van de data voor training om te testen*

*>>> train\_split\_index = int(model.factors.shape[1] \* 0.8)*

*>>> data\_train = Y\_train\_std[:, :train\_split\_index].T*

*>>> fac\_train = model.factors[:, :train\_split\_index].T*

*>>>*

*>>> # Train het ElasticNet-model*

*>>> B\_matrix, r2\_insample, intercept = model.enet\_fit(data\_train, fac\_train)*

*>>>*

*>>> # Inspecteer de resultaten*

*>>> print("Shape of B\_matrix (ElasticNet coefficients):", B\_matrix.shape)*

*Shape of B\_matrix (ElasticNet coefficients): (66, 9)*

*>>> print("First few coefficients of B\_matrix:\n", B\_matrix[:5, :5])*

*First few coefficients of B\_matrix:*

*[[ 0.04088399 0.08592133 -0.01551943 -0.02031759 0.00576677]*

*[ 0.01990409 0.04395976 -0.01622239 -0.00101789 -0.07826501]*

*[ 0.03348446 0.06306993 -0.00249369 -0.00724524 -0.03015038]*

*[ 0.0243287 0.07147932 -0.01749151 -0.01492411 -0.02055175]*

*[ 0.01565931 0.03460863 -0.01010059 0.02615383 -0.05804405]]*

*>>> print("In-sample R^2 value:", r2\_insample)*

*In-sample R^2 value: 0.7645413976926512*

*>>>*

## Stap 3: Voorspel factoren met Yule-Walker

Met het geschatte model en de factoren tot de laatste tijdstempel in de trainingsset, gebruik je de Yule-Walker vergelijking om de factoren voor de volgende tijdstempel t+1 te voorspellen.

Dit betekent dat je gebruik maakt van de geschatte autoregressieve parameters (phi) om toekomstige waarden van de factoren te schatten.

*CHECK*

*Dit is de terminal output na check stap 3:*

*>>> # Begin met het importeren van de benodigde libraries en modules*

*>>> import pandas as pd*

*>>> from data\_loader import load\_data, filter\_data*

*>>> from utils import standardize*

*>>> from factor\_model import DynamicFactorModel*

*>>>*

*>>> # Laad en filter data*

*>>> file\_path = 'C:/Thesis/03. Data/Final version data/Static.xlsx'*

*>>> df\_data = load\_data(file\_path)*

*>>> filtered\_df = filter\_data(df\_data)*

*>>>*

*>>> # Definieer de trainingsperiode*

*>>> DATE\_TRAIN\_END = pd.Period('2019-12', freq='M')*

*>>>*

*>>> # Splits de data in de trainingsset*

*>>> Y\_train = filtered\_df.loc[:, :DATE\_TRAIN\_END] # Data tot en met 2019-12*

*>>>*

*>>> # Standaardiseer de trainingsdata*

*>>> Y\_train\_std = standardize(Y\_train.values.T).T*

*>>>*

*>>> # Initialiseer het model en pas PCA toe*

*>>> num\_factors = 9 # Gebruik bijvoorbeeld 9 factoren voor deze test*

*>>> model = DynamicFactorModel(Y\_train, num\_factors)*

*>>> model.std\_data = Y\_train\_std.T*

*>>> model.apply\_pca() # PCA toepassen om factoren te extraheren*

*>>>*

*>>> # Yule-Walker schatting uitvoeren*

*>>> model.yw\_estimation()*

*>>>*

*>>> # Voorspel factoren voor de volgende tijdstempel na de laatste van de trainingsset*

*>>> next\_timestamp = '2020-01' # De volgende maand na de laatste trainingsmaand*

*>>> factor\_forecast = model.factor\_forecast(next\_timestamp, scenarios=1)*

*>>>*

*>>> # Inspecteer de voorspelde factoren*

*>>> print("Predicted factors for '2020-01':\n", factor\_forecast)*

*Predicted factors for '2020-01':*

*[[-5.530608 -1.18141764 -0.33418304 -1.17280904 0.14506855 0.20184185*

*0.34628876 0.09120053 0.03231743]]*

*>>>*

## Stap 4: Voorspel variabelen op basis van factoren t+1

Nu gebruik je het getrainde ElasticNet-model en de voorspelde factoren van tijdstempel t+1om de 66 variabelen op tijdstempel t+1 te voorspellen.

Dit geeft je een nieuwe voorspelde waarde voor elke variabele in de dataset.

*CHECK*

*Dit is de terminal output na check stap 4: runnen van mainPCAstatic.py:*

*PS C:\Thesis\04. Models> & C:/Users/mayac/AppData/Local/Microsoft/WindowsApps/python3.12.exe "c:/Thesis/04. Models/mainPCAstatic.py"*

*Evaluating model with 5 factors*

*Shape of factor\_forecast before transpose: (1, 5)*

*Predicted variables for 2020-01:*

*[[-0.30573665 0.25379218 0.17394232 -0.03927756 0.17468824 -0.43481686*

*-0.30174791 -0.36659139 0.3350193 -0.201414 -0.06073403 0.00964723*

*0.10923181 -0.01104068 0.36003988 0.66754804 0.12590809 0.44714363*

*0.32582807 0.46635958 0.42172514 -0.01948389 4.23809916 0.5240047*

*0.44751704 0.28602827 1.06095044 6.20614349 1.01684909 -0.19310037*

*0.81221461 0.88590477 -0.65966454 0.81175362 0.75482848 0.74017354*

*0.76261498 0.55640286 0.72223207 0.57103695 0.70198015 0.72851762*

*0.65486298 0.61108392 -1.28173351 -0.99399939 -0.8905397 -0.6535491*

*-0.06239688 -0.88254897 -0.88254897 -1.10199297 -0.2058529 -1.01858023*

*-0.92553801 -0.96992353 -1.18624003 -0.89861576 -0.53870414 0.36276693*

*-1.26884328 -0.800633 -0.90114051 -0.16067056 -0.85532542 -0.8717549 ]]*

*Evaluating model with 6 factors*

*Shape of factor\_forecast before transpose: (1, 6)*

*Predicted variables for 2020-01:*

*[[-0.30661141 0.25084453 0.1726358 -0.04111718 0.17393465 -0.43647241*

*-0.30038177 -0.37075752 0.3338386 -0.20104233 -0.06301578 0.0082263*

*0.10221985 -0.01868239 0.34966773 0.65685461 0.11830109 0.44199808*

*0.31683962 0.46350612 0.41451037 -0.02391383 4.2607088 0.51663349*

*0.44374794 0.31299064 1.09282787 6.17687941 0.99778115 -0.15981681*

*0.82343602 0.89152513 -0.65047436 0.81374399 0.75747968 0.74282155*

*0.76264347 0.55897221 0.72548365 0.57165635 0.70400065 0.72890001*

*0.65684123 0.61527671 -1.2808081 -0.99330019 -0.88995105 -0.6532884*

*-0.06185025 -0.88167567 -0.88167567 -1.10201184 -0.20568886 -1.01767952*

*-0.92371692 -0.97143785 -1.18561877 -0.89835101 -0.53875604 0.36275293*

*-1.26962147 -0.79881848 -0.90243447 -0.16036632 -0.85416908 -0.86994462]]*

*Evaluating model with 7 factors*

*Shape of factor\_forecast before transpose: (1, 7)*

*Predicted variables for 2020-01:*

*[[-3.16581788e-01 2.12793183e-01 1.52306782e-01 -5.79990102e-02*

*1.43010709e-01 -4.45006590e-01 -3.02183349e-01 -4.10515110e-01*

*3.12416282e-01 -2.07426122e-01 -1.08231850e-01 2.39094437e-03*

*-4.44167852e-03 -1.34744954e-01 1.92243491e-01 5.44053519e-01*

*7.74951313e-02 3.93608585e-01 1.72098329e-01 3.67433626e-01*

*3.08244959e-01 -1.03326300e-01 4.40597987e+00 5.13868543e-01*

*4.40343026e-01 3.07918636e-01 1.12935187e+00 6.26575493e+00*

*1.00859625e+00 -1.23367535e-01 8.41513372e-01 9.03201351e-01*

*-6.25149398e-01 8.42417440e-01 8.03548963e-01 7.88145890e-01*

*7.84965770e-01 5.85197714e-01 7.54874182e-01 5.82745111e-01*

*7.55843284e-01 7.51232113e-01 6.82347689e-01 6.79627998e-01*

*-1.24449014e+00 -9.61037287e-01 -8.51991012e-01 -6.24433484e-01*

*-4.64509101e-02 -8.43966343e-01 -8.43966343e-01 -1.05906267e+00*

*-1.86087649e-01 -9.82318621e-01 -8.96917888e-01 -9.81132056e-01*

*-1.19885089e+00 -8.86361836e-01 -5.48544928e-01 3.63863955e-01*

*-1.27624186e+00 -7.99378322e-01 -9.05095731e-01 -1.66558227e-01*

*-8.66441667e-01 -8.83059220e-01]]*

*Evaluating model with 8 factors*

*Shape of factor\_forecast before transpose: (1, 8)*

*Predicted variables for 2020-01:*

*[[-3.21104350e-01 2.13303374e-01 1.52558800e-01 -5.82785437e-02*

*1.40370743e-01 -4.45017441e-01 -3.03030167e-01 -4.09749234e-01*

*3.11334174e-01 -2.09186501e-01 -1.09153285e-01 3.57777203e-03*

*-4.73952088e-03 -1.34317114e-01 1.95057930e-01 5.36567300e-01*

*7.57427987e-02 3.88373946e-01 1.75938740e-01 3.66632686e-01*

*3.07901455e-01 -1.04939158e-01 4.41196604e+00 5.71232178e-01*

*3.47601377e-01 3.24053489e-01 1.09156058e+00 6.27100482e+00*

*1.00653638e+00 -1.10735230e-01 8.29989833e-01 9.31148484e-01*

*-5.71545223e-01 8.42279950e-01 8.02497836e-01 7.91217232e-01*

*7.83770056e-01 5.86096580e-01 7.55291638e-01 5.82498516e-01*

*7.52683656e-01 7.50265774e-01 6.82488856e-01 6.80393788e-01*

*-1.24633522e+00 -9.62610013e-01 -8.53290246e-01 -6.25930781e-01*

*-4.85066352e-02 -8.43975186e-01 -8.43975186e-01 -1.05997721e+00*

*-1.86966953e-01 -9.85147685e-01 -8.99045940e-01 -9.83638243e-01*

*-1.19831268e+00 -8.87248082e-01 -5.48276164e-01 3.64253199e-01*

*-1.28052455e+00 -7.95061734e-01 -9.05223654e-01 -1.67702710e-01*

*-8.67804379e-01 -8.87214069e-01]]*

*Evaluating model with 9 factors*

*Shape of factor\_forecast before transpose: (1, 9)*

*Predicted variables for 2020-01:*

*[[-3.21273996e-01 2.12880830e-01 1.52249377e-01 -5.88864875e-02*

*1.39898029e-01 -4.45469472e-01 -3.03476897e-01 -4.10159858e-01*

*3.11204436e-01 -2.09335727e-01 -1.09870123e-01 3.46312864e-03*

*-4.98827965e-03 -1.34630414e-01 1.94654305e-01 5.36139970e-01*

*7.68605918e-02 3.87838075e-01 1.75159033e-01 3.65781021e-01*

*3.06854666e-01 -1.05146301e-01 4.41248015e+00 5.71857422e-01*

*3.43724672e-01 3.21478274e-01 1.09156135e+00 6.27446678e+00*

*1.01500490e+00 -9.79703171e-02 8.19718137e-01 9.26612730e-01*

*-5.76038908e-01 8.42250162e-01 8.02567671e-01 7.91995167e-01*

*7.83680066e-01 5.86164115e-01 7.54980912e-01 5.82860146e-01*

*7.52902148e-01 7.50446552e-01 6.82730810e-01 6.80712912e-01*

*-1.24576327e+00 -9.62147141e-01 -8.52927373e-01 -6.25756618e-01*

*-4.83674570e-02 -8.43695390e-01 -8.43695390e-01 -1.05950700e+00*

*-1.86892141e-01 -9.84838956e-01 -8.98609353e-01 -9.83884194e-01*

*-1.19855359e+00 -8.87194103e-01 -5.49022888e-01 3.64187967e-01*

*-1.28147378e+00 -7.95507747e-01 -9.05953839e-01 -1.68309725e-01*

*-8.68814349e-01 -8.87765658e-01]]*

*Evaluating model with 10 factors*

*Shape of factor\_forecast before transpose: (1, 10)*

*Predicted variables for 2020-01:*

*[[-3.19643579e-01 2.13006548e-01 1.52440826e-01 -5.85026166e-02*

*1.39278104e-01 -4.43976173e-01 -3.04236868e-01 -4.09695127e-01*

*3.10453024e-01 -2.09412205e-01 -1.09247294e-01 1.96133810e-03*

*-5.83878326e-03 -1.34607666e-01 1.95172051e-01 5.37016444e-01*

*7.60622759e-02 3.87134760e-01 1.74141673e-01 3.65283629e-01*

*3.06439575e-01 -1.06364829e-01 4.40971334e+00 5.60883172e-01*

*3.36348873e-01 3.46798294e-01 1.08397091e+00 6.28505021e+00*

*1.05354695e+00 -7.64415057e-02 8.35820547e-01 9.37313456e-01*

*-5.76757497e-01 8.42355995e-01 8.02910219e-01 7.91896882e-01*

*7.84027322e-01 5.85764690e-01 7.54882903e-01 5.82704294e-01*

*7.53129221e-01 7.50573911e-01 6.82687538e-01 6.80662343e-01*

*-1.24603357e+00 -9.62174495e-01 -8.52814836e-01 -6.25553780e-01*

*-4.85105785e-02 -8.43959634e-01 -8.43959634e-01 -1.05957690e+00*

*-1.86785991e-01 -9.84780274e-01 -8.98633746e-01 -9.84133271e-01*

*-1.19931741e+00 -8.87952720e-01 -5.49195517e-01 3.64145452e-01*

*-1.28153304e+00 -7.97410715e-01 -9.06424594e-01 -1.68159713e-01*

*-8.69453834e-01 -8.87958495e-01]]*

*Evaluating model with 11 factors*

*Shape of factor\_forecast before transpose: (1, 11)*

*Predicted variables for 2020-01:*

*[[-3.20979249e-01 2.14343661e-01 1.53765266e-01 -5.75026393e-02*

*1.39662877e-01 -4.46103927e-01 -3.03197927e-01 -4.08360755e-01*

*3.09977448e-01 -2.09687418e-01 -1.07771555e-01 3.55055108e-04*

*-2.85501340e-03 -1.31601356e-01 2.01621912e-01 5.42343623e-01*

*7.31517851e-02 3.86715335e-01 1.81105069e-01 3.70335506e-01*

*3.12692045e-01 -1.03886427e-01 4.45380399e+00 5.87613945e-01*

*3.89668021e-01 4.49356185e-01 1.10156960e+00 6.30539940e+00*

*1.08648411e+00 -4.59626696e-02 8.75702791e-01 9.78581943e-01*

*-5.29585109e-01 8.42018274e-01 8.02029336e-01 7.90473715e-01*

*7.83251354e-01 5.84949290e-01 7.54919359e-01 5.82307970e-01*

*7.50914985e-01 7.49815014e-01 6.81580483e-01 6.77930071e-01*

*-1.25124886e+00 -9.67001885e-01 -8.58017634e-01 -6.28997134e-01*

*-5.09667237e-02 -8.48055319e-01 -8.48055319e-01 -1.06572277e+00*

*-1.89117415e-01 -9.89738091e-01 -9.01662789e-01 -9.86030074e-01*

*-1.20106800e+00 -8.90745578e-01 -5.48905132e-01 3.63611172e-01*

*-1.28431768e+00 -7.98885842e-01 -9.08917419e-01 -1.67670440e-01*

*-8.68824156e-01 -8.87057705e-01]]*

*Evaluating model with 12 factors*

*Shape of factor\_forecast before transpose: (1, 12)*

*Predicted variables for 2020-01:*

*[[-3.14013570e-01 2.15647448e-01 1.50143928e-01 -5.79792105e-02*

*1.24474731e-01 -4.40324641e-01 -3.10330885e-01 -4.05353542e-01*

*3.07786369e-01 -2.19863260e-01 -1.10312422e-01 -4.02284561e-03*

*-7.81017561e-03 -1.32475443e-01 2.09427768e-01 5.47926603e-01*

*7.10542503e-02 3.71093684e-01 1.94473076e-01 3.69020768e-01*

*3.14103049e-01 -1.13847282e-01 4.55686213e+00 6.43323989e-01*

*2.10395002e-01 3.47154895e-01 1.04602050e+00 6.38624932e+00*

*1.14072174e+00 -2.49353858e-01 7.86520083e-01 1.00673599e+00*

*-4.97538183e-01 8.41284227e-01 8.02869236e-01 7.93529543e-01*

*7.82066899e-01 5.84470398e-01 7.51283499e-01 5.80592594e-01*

*7.45603174e-01 7.48511650e-01 6.80205981e-01 6.78849559e-01*

*-1.26107002e+00 -9.74472144e-01 -8.64722172e-01 -6.35075416e-01*

*-5.76234934e-02 -8.49830205e-01 -8.49830205e-01 -1.07111298e+00*

*-1.91750704e-01 -1.00158190e+00 -9.14608791e-01 -9.90362656e-01*

*-1.20305019e+00 -8.88745673e-01 -5.46613050e-01 3.62741365e-01*

*-1.29937268e+00 -7.86863301e-01 -9.06957071e-01 -1.67600564e-01*

*-8.80161405e-01 -9.00853688e-01]]*

*Results saved to results\_PCAstatic\_with\_AIC\_BIC\_AdjustedR2\_LogLikelihood\_Residuals.xlsx*

*PS C:\Thesis\04. Models>*

## Stap 5: Maak twee nieuwe matrices

Een matrix voor de voorspelde factoren vanaf tijdstempel t+1.

Een matrix voor de voorspelde variabelen vanaf tijdstempel t+1.

*CHECK*

*Dit is de terminal output na check stap 5: runnen van mainPCAstatic.py:*

*PS C:\Thesis\04. Models> & C:/Users/mayac/AppData/Local/Microsoft/WindowsApps/python3.12.exe "c:/Thesis/04. Models/mainPCAstatic.py"*

*Evaluating model with 5 factors*

*Predicted variables for 2020-01:*

*[[-0.30573665 0.25379218 0.17394232 -0.03927756 0.17468824 -0.43481686*

*-0.30174791 -0.36659139 0.3350193 -0.201414 -0.06073403 0.00964723*

*0.10923181 -0.01104068 0.36003988 0.66754804 0.12590809 0.44714363*

*0.32582807 0.46635958 0.42172514 -0.01948389 4.23809916 0.5240047*

*0.44751704 0.28602827 1.06095044 6.20614349 1.01684909 -0.19310037*

*0.81221461 0.88590477 -0.65966454 0.81175362 0.75482848 0.74017354*

*0.76261498 0.55640286 0.72223207 0.57103695 0.70198015 0.72851762*

*0.65486298 0.61108392 -1.28173351 -0.99399939 -0.8905397 -0.6535491*

*-0.06239688 -0.88254897 -0.88254897 -1.10199297 -0.2058529 -1.01858023*

*-0.92553801 -0.96992353 -1.18624003 -0.89861576 -0.53870414 0.36276693*

*-1.26884328 -0.800633 -0.90114051 -0.16067056 -0.85532542 -0.8717549 ]]*

*Evaluating model with 6 factors*

*Predicted variables for 2020-01:*

*[[-0.30661141 0.25084453 0.1726358 -0.04111718 0.17393465 -0.43647241*

*-0.30038177 -0.37075752 0.3338386 -0.20104233 -0.06301578 0.0082263*

*0.10221985 -0.01868239 0.34966773 0.65685461 0.11830109 0.44199808*

*0.31683962 0.46350612 0.41451037 -0.02391383 4.2607088 0.51663349*

*0.44374794 0.31299064 1.09282787 6.17687941 0.99778115 -0.15981681*

*0.82343602 0.89152513 -0.65047436 0.81374399 0.75747968 0.74282155*

*0.76264347 0.55897221 0.72548365 0.57165635 0.70400065 0.72890001*

*0.65684123 0.61527671 -1.2808081 -0.99330019 -0.88995105 -0.6532884*

*-0.06185025 -0.88167567 -0.88167567 -1.10201184 -0.20568886 -1.01767952*

*-0.92371692 -0.97143785 -1.18561877 -0.89835101 -0.53875604 0.36275293*

*-1.26962147 -0.79881848 -0.90243447 -0.16036632 -0.85416908 -0.86994462]]*

*Evaluating model with 7 factors*

*Predicted variables for 2020-01:*

*[[-3.16581788e-01 2.12793183e-01 1.52306782e-01 -5.79990102e-02*

*1.43010709e-01 -4.45006590e-01 -3.02183349e-01 -4.10515110e-01*

*3.12416282e-01 -2.07426122e-01 -1.08231850e-01 2.39094437e-03*

*-4.44167852e-03 -1.34744954e-01 1.92243491e-01 5.44053519e-01*

*7.74951313e-02 3.93608585e-01 1.72098329e-01 3.67433626e-01*

*3.08244959e-01 -1.03326300e-01 4.40597987e+00 5.13868543e-01*

*4.40343026e-01 3.07918636e-01 1.12935187e+00 6.26575493e+00*

*1.00859625e+00 -1.23367535e-01 8.41513372e-01 9.03201351e-01*

*-6.25149398e-01 8.42417440e-01 8.03548963e-01 7.88145890e-01*

*7.84965770e-01 5.85197714e-01 7.54874182e-01 5.82745111e-01*

*7.55843284e-01 7.51232113e-01 6.82347689e-01 6.79627998e-01*

*-1.24449014e+00 -9.61037287e-01 -8.51991012e-01 -6.24433484e-01*

*-4.64509101e-02 -8.43966343e-01 -8.43966343e-01 -1.05906267e+00*

*-1.86087649e-01 -9.82318621e-01 -8.96917888e-01 -9.81132056e-01*

*-1.19885089e+00 -8.86361836e-01 -5.48544928e-01 3.63863955e-01*

*-1.27624186e+00 -7.99378322e-01 -9.05095731e-01 -1.66558227e-01*

*-8.66441667e-01 -8.83059220e-01]]*

*Evaluating model with 8 factors*

*Predicted variables for 2020-01:*

*[[-3.21104350e-01 2.13303374e-01 1.52558800e-01 -5.82785437e-02*

*1.40370743e-01 -4.45017441e-01 -3.03030167e-01 -4.09749234e-01*

*3.11334174e-01 -2.09186501e-01 -1.09153285e-01 3.57777203e-03*

*-4.73952088e-03 -1.34317114e-01 1.95057930e-01 5.36567300e-01*

*7.57427987e-02 3.88373946e-01 1.75938740e-01 3.66632686e-01*

*3.07901455e-01 -1.04939158e-01 4.41196604e+00 5.71232178e-01*

*3.47601377e-01 3.24053489e-01 1.09156058e+00 6.27100482e+00*

*1.00653638e+00 -1.10735230e-01 8.29989833e-01 9.31148484e-01*

*-5.71545223e-01 8.42279950e-01 8.02497836e-01 7.91217232e-01*

*7.83770056e-01 5.86096580e-01 7.55291638e-01 5.82498516e-01*

*7.52683656e-01 7.50265774e-01 6.82488856e-01 6.80393788e-01*

*-1.24633522e+00 -9.62610013e-01 -8.53290246e-01 -6.25930781e-01*

*-4.85066352e-02 -8.43975186e-01 -8.43975186e-01 -1.05997721e+00*

*-1.86966953e-01 -9.85147685e-01 -8.99045940e-01 -9.83638243e-01*

*-1.19831268e+00 -8.87248082e-01 -5.48276164e-01 3.64253199e-01*

*-1.28052455e+00 -7.95061734e-01 -9.05223654e-01 -1.67702710e-01*

*-8.67804379e-01 -8.87214069e-01]]*

*Evaluating model with 9 factors*

*Predicted variables for 2020-01:*

*[[-3.21273996e-01 2.12880830e-01 1.52249377e-01 -5.88864875e-02*

*1.39898029e-01 -4.45469472e-01 -3.03476897e-01 -4.10159858e-01*

*3.11204436e-01 -2.09335727e-01 -1.09870123e-01 3.46312864e-03*

*-4.98827965e-03 -1.34630414e-01 1.94654305e-01 5.36139970e-01*

*7.68605918e-02 3.87838075e-01 1.75159033e-01 3.65781021e-01*

*3.06854666e-01 -1.05146301e-01 4.41248015e+00 5.71857422e-01*

*3.43724672e-01 3.21478274e-01 1.09156135e+00 6.27446678e+00*

*1.01500490e+00 -9.79703171e-02 8.19718137e-01 9.26612730e-01*

*-5.76038908e-01 8.42250162e-01 8.02567671e-01 7.91995167e-01*

*7.83680066e-01 5.86164115e-01 7.54980912e-01 5.82860146e-01*

*7.52902148e-01 7.50446552e-01 6.82730810e-01 6.80712912e-01*

*-1.24576327e+00 -9.62147141e-01 -8.52927373e-01 -6.25756618e-01*

*-4.83674570e-02 -8.43695390e-01 -8.43695390e-01 -1.05950700e+00*

*-1.86892141e-01 -9.84838956e-01 -8.98609353e-01 -9.83884194e-01*

*-1.19855359e+00 -8.87194103e-01 -5.49022888e-01 3.64187967e-01*

*-1.28147378e+00 -7.95507747e-01 -9.05953839e-01 -1.68309725e-01*

*-8.68814349e-01 -8.87765658e-01]]*

*Evaluating model with 10 factors*

*Predicted variables for 2020-01:*

*[[-3.19643579e-01 2.13006548e-01 1.52440826e-01 -5.85026166e-02*

*1.39278104e-01 -4.43976173e-01 -3.04236868e-01 -4.09695127e-01*

*3.10453024e-01 -2.09412205e-01 -1.09247294e-01 1.96133810e-03*

*-5.83878326e-03 -1.34607666e-01 1.95172051e-01 5.37016444e-01*

*7.60622759e-02 3.87134760e-01 1.74141673e-01 3.65283629e-01*

*3.06439575e-01 -1.06364829e-01 4.40971334e+00 5.60883172e-01*

*3.36348873e-01 3.46798294e-01 1.08397091e+00 6.28505021e+00*

*1.05354695e+00 -7.64415057e-02 8.35820547e-01 9.37313456e-01*

*-5.76757497e-01 8.42355995e-01 8.02910219e-01 7.91896882e-01*

*7.84027322e-01 5.85764690e-01 7.54882903e-01 5.82704294e-01*

*7.53129221e-01 7.50573911e-01 6.82687538e-01 6.80662343e-01*

*-1.24603357e+00 -9.62174495e-01 -8.52814836e-01 -6.25553780e-01*

*-4.85105785e-02 -8.43959634e-01 -8.43959634e-01 -1.05957690e+00*

*-1.86785991e-01 -9.84780274e-01 -8.98633746e-01 -9.84133271e-01*

*-1.19931741e+00 -8.87952720e-01 -5.49195517e-01 3.64145452e-01*

*-1.28153304e+00 -7.97410715e-01 -9.06424594e-01 -1.68159713e-01*

*-8.69453834e-01 -8.87958495e-01]]*

*Evaluating model with 11 factors*

*Predicted variables for 2020-01:*

*[[-3.20979249e-01 2.14343661e-01 1.53765266e-01 -5.75026393e-02*

*1.39662877e-01 -4.46103927e-01 -3.03197927e-01 -4.08360755e-01*

*3.09977448e-01 -2.09687418e-01 -1.07771555e-01 3.55055108e-04*

*-2.85501340e-03 -1.31601356e-01 2.01621912e-01 5.42343623e-01*

*7.31517851e-02 3.86715335e-01 1.81105069e-01 3.70335506e-01*

*3.12692045e-01 -1.03886427e-01 4.45380399e+00 5.87613945e-01*

*3.89668021e-01 4.49356185e-01 1.10156960e+00 6.30539940e+00*

*1.08648411e+00 -4.59626696e-02 8.75702791e-01 9.78581943e-01*

*-5.29585109e-01 8.42018274e-01 8.02029336e-01 7.90473715e-01*

*7.83251354e-01 5.84949290e-01 7.54919359e-01 5.82307970e-01*

*7.50914985e-01 7.49815014e-01 6.81580483e-01 6.77930071e-01*

*-1.25124886e+00 -9.67001885e-01 -8.58017634e-01 -6.28997134e-01*

*-5.09667237e-02 -8.48055319e-01 -8.48055319e-01 -1.06572277e+00*

*-1.89117415e-01 -9.89738091e-01 -9.01662789e-01 -9.86030074e-01*

*-1.20106800e+00 -8.90745578e-01 -5.48905132e-01 3.63611172e-01*

*-1.28431768e+00 -7.98885842e-01 -9.08917419e-01 -1.67670440e-01*

*-8.68824156e-01 -8.87057705e-01]]*

*Evaluating model with 12 factors*

*Predicted variables for 2020-01:*

*[[-3.14013570e-01 2.15647448e-01 1.50143928e-01 -5.79792105e-02*

*1.24474731e-01 -4.40324641e-01 -3.10330885e-01 -4.05353542e-01*

*3.07786369e-01 -2.19863260e-01 -1.10312422e-01 -4.02284561e-03*

*-7.81017561e-03 -1.32475443e-01 2.09427768e-01 5.47926603e-01*

*7.10542503e-02 3.71093684e-01 1.94473076e-01 3.69020768e-01*

*3.14103049e-01 -1.13847282e-01 4.55686213e+00 6.43323989e-01*

*2.10395002e-01 3.47154895e-01 1.04602050e+00 6.38624932e+00*

*1.14072174e+00 -2.49353858e-01 7.86520083e-01 1.00673599e+00*

*-4.97538183e-01 8.41284227e-01 8.02869236e-01 7.93529543e-01*

*7.82066899e-01 5.84470398e-01 7.51283499e-01 5.80592594e-01*

*7.45603174e-01 7.48511650e-01 6.80205981e-01 6.78849559e-01*

*-1.26107002e+00 -9.74472144e-01 -8.64722172e-01 -6.35075416e-01*

*-5.76234934e-02 -8.49830205e-01 -8.49830205e-01 -1.07111298e+00*

*-1.91750704e-01 -1.00158190e+00 -9.14608791e-01 -9.90362656e-01*

*-1.20305019e+00 -8.88745673e-01 -5.46613050e-01 3.62741365e-01*

*-1.29937268e+00 -7.86863301e-01 -9.06957071e-01 -1.67600564e-01*

*-8.80161405e-01 -9.00853688e-01]]*

*Results saved to results\_PCAstatic\_with\_AIC\_BIC\_AdjustedR2\_LogLikelihood\_Residuals.xlsx*

*Predicted factors and variables matrices saved to separate Excel files for each number of factors.*

*PS C:\Thesis\04. Models>*

## Stap 6: Hertrain het model met nieuwe voorspellingen

Gebruik nu alle data (inclusief de voorspellingen tot tijdstempel t+1) om je model opnieuw te schatten. Dit betekent dat je je factormodel (bijvoorbeeld PCA) opnieuw toepast op de geüpdatete dataset.

Voorspel de factoren en variabelen voor tijdstempel t+2.

## Stap 7: Voeg voorspellingen toe en herhaal tot tijdshorizon T

Voeg de voorspellingen voor t+2 toe aan je matrices.

Herhaal deze procedure om door te gaan met voorspellen voor toekomstige tijdstempels tot je een bepaalde tijdshorizon T hebt bereikt.

## Vraag aan chat:

* Waar in al mijn scripts voer ik stap X uit?
* Geloof je dat we stap X correct uitvoeren?
* Hoe kunnen we even kort tussendoor inspecteren of dit goed gaat? Kan ik een command in de terminal runnen?
* Klopt deze output in de terminal bij onze verwachtingen?